UNLV Zero or Near-Zero Energy House Projects in Las Vegas

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Experiences with Zero or Near Zero Energy Houses

- Project 1. Funded in 2004 by NREL. Worked with a builder in Las Vegas to develop a ZEH similar to general tract houses in Las Vegas. Monitor. Compared to conventional house.
- Project 2. Funded in 2008 by NV Energy with PUCN pass-through funding. Pulte Homes and UNLV to determine cost/benefit ratio for moving toward ZEH construction.
- Project 3. New, funded by DOE to UNLV. Works with Pulte Homes and NV Energy to decrease substantially peak energy demand of a total development.

Fact of Life: Las Vegas

- Summer times are long and hot
- Very little night time cooling occurs here
- 24 hour air conditioning is clearly the dominant energy load
- This greatly exacerbates to the peak energy demand on the electric utility
- Public Utility Commission is encouraging evaluation of programs that will decrease the peak demand

First Project: Construction

"Baseline" Home ZEH

- One typical tract house built to code. One designed on same plan but modified under the skin to ZEH.
- Identical but mirrored floor plan.
- Roof of ZEH oriented to give better north-south exposure for roof-mounted solar components.

Construction

Some of the ZEH Modifications:

- T-mass walls,
- Exterior slab insulation and added attic insulation,
- Reflective roof sheeting,
- Spectrally selective windows, large overhangs over patio doors,
- Compact fluorescent lighting,
- Freus high efficiency water-cooled condenser AC,
- HVAC ducting installed in conditioned spaces,
- On-demand tankless water heater,
- Integrated storage collector solar water heater for hot water makeup,
- 5-kWe roof integrated photovoltaic panels.

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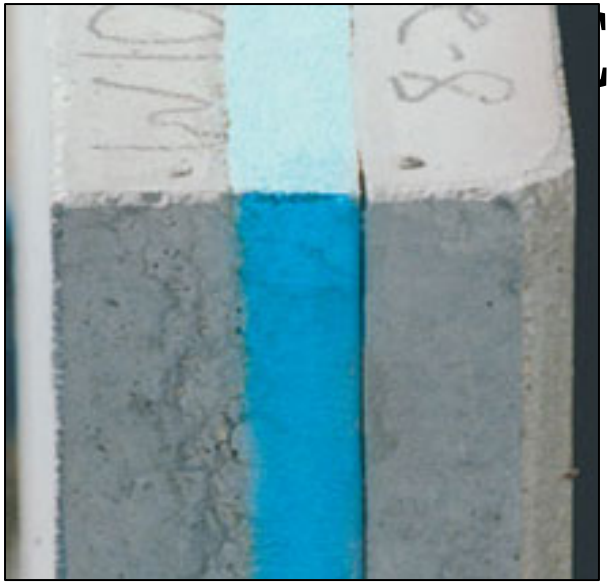
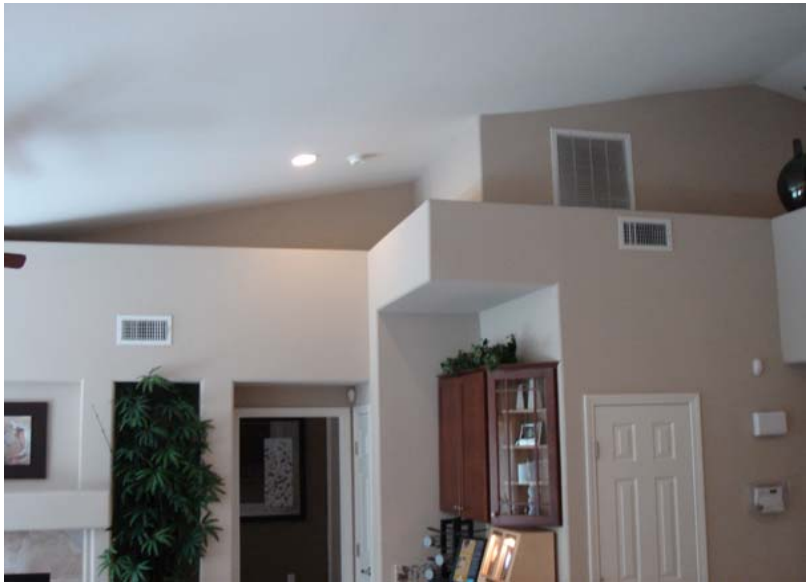
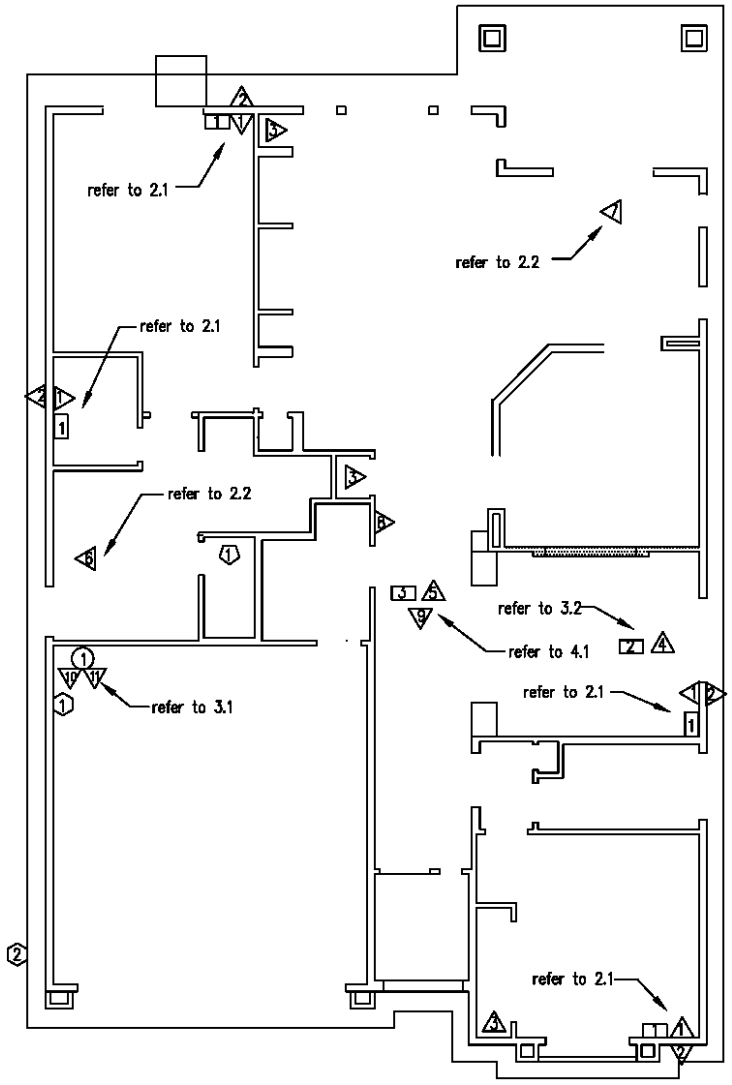


Construction



Data Monitoring



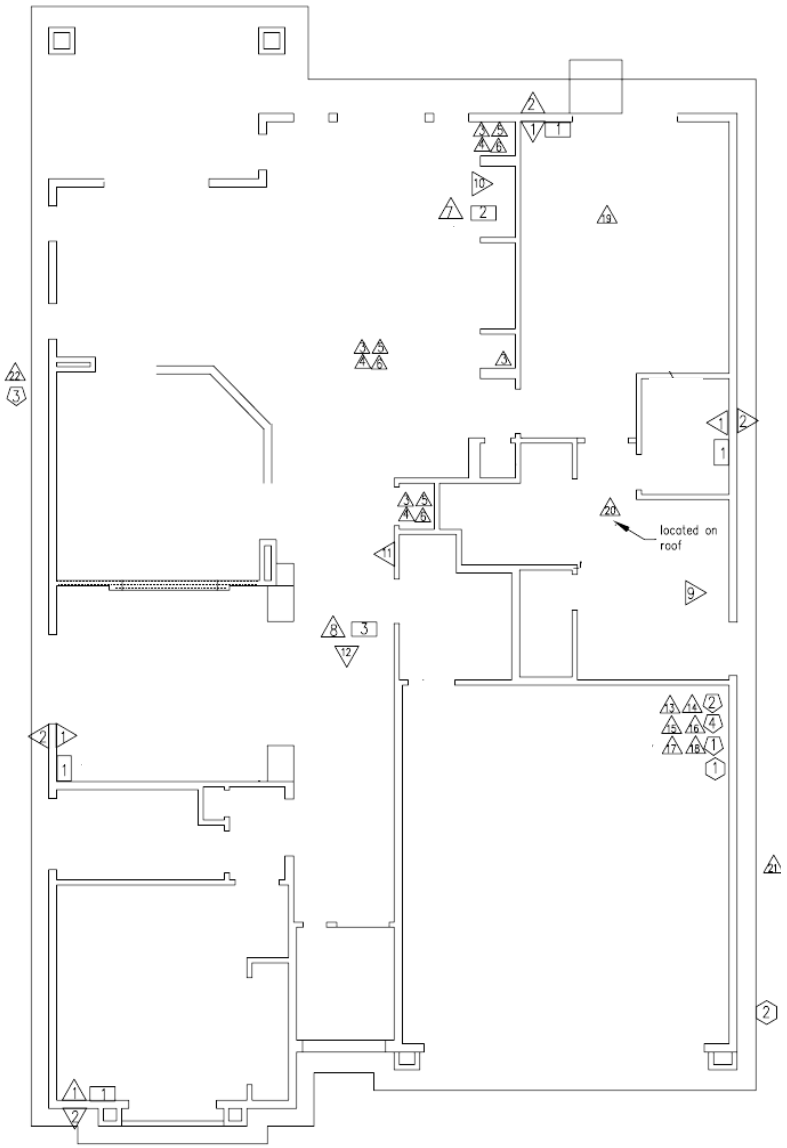
Monitoring Sensors:

Temperatures:

- Exterior walls - 4 locations
- Attic air - 2 locations
- Room air - 2 locations
- Supply air - 2 locations
- Water heaters - hot and cold water.
- Slab (Baseline) - 3 locations
- Slab and pad (ZEH) - 4 locations at various depths
- Exterior soil temperature (ZEH)
- Freus AC water sump (ZEH)
- AC hydronic heating coil water (ZEH)
- PV plate temperatures - 2 locations (ZEH)
- Ambient air

“Baseline” Floor Plan

Data Monitoring



Monitoring Sensors cont:

Heat Flux:

- Inside surface of exterior walls - 4 locations
- Ceiling surfaces - 2 locations

Hot Water Energy Flow:

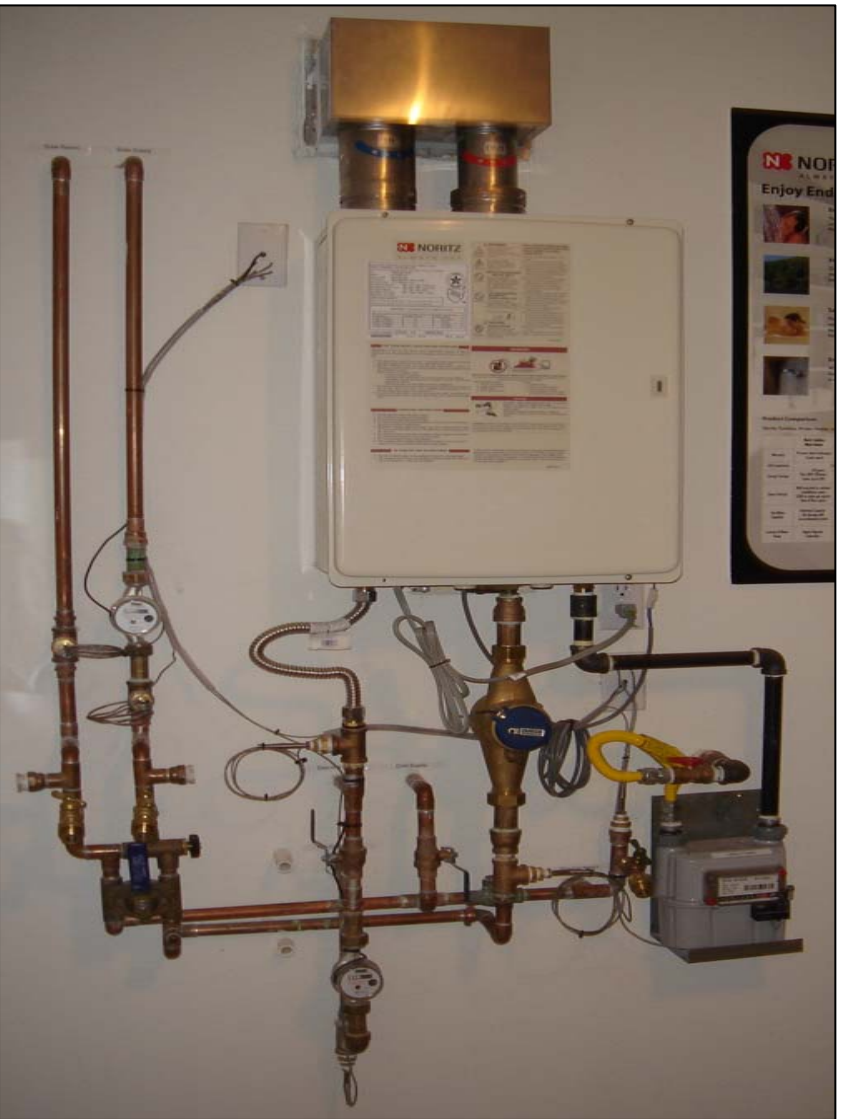
- Water meter for water heaters
- Water meter for solar water heater (ZEH)
- Hydronic heating coil (ZEH)

Water Consumption:

- Whole house pulse meter
- Hot water
- Freus air conditioner water meter (ZEH)

ZEH Floor Plan

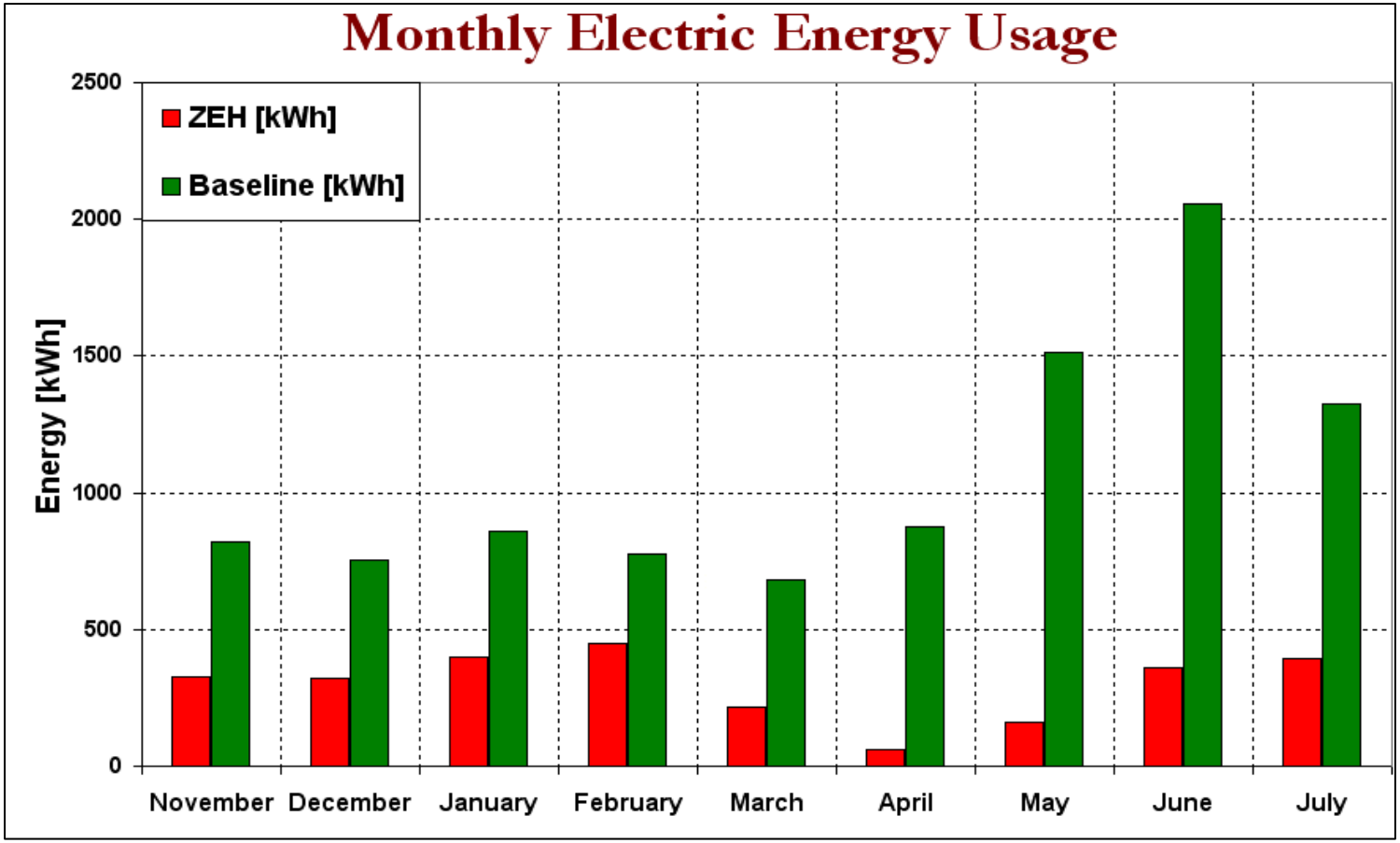
Data Monitoring



- Whole house gas consumption for both houses is measured with RIOTronics PulsePoint retrofit gas meter pulse devices which were added to the main house gas meters by the gas utility,
- gas consumption for the water heaters for both houses and the gas furnace in the Baseline house are measured using E-Mon Model 200CFGM gas meters with pulse outputs,
- Omega and Seametrics Flow meters used to measure water flows,
- Omega Thin Film Heat Flux sensors are used to measure heat flux through walls and ceilings,
- Various J-type thermocouples are used to measure temperatures.

Data is currently logged in one minute increments and downloaded remotely to a server at UNLV for analysis.

Data Analysis

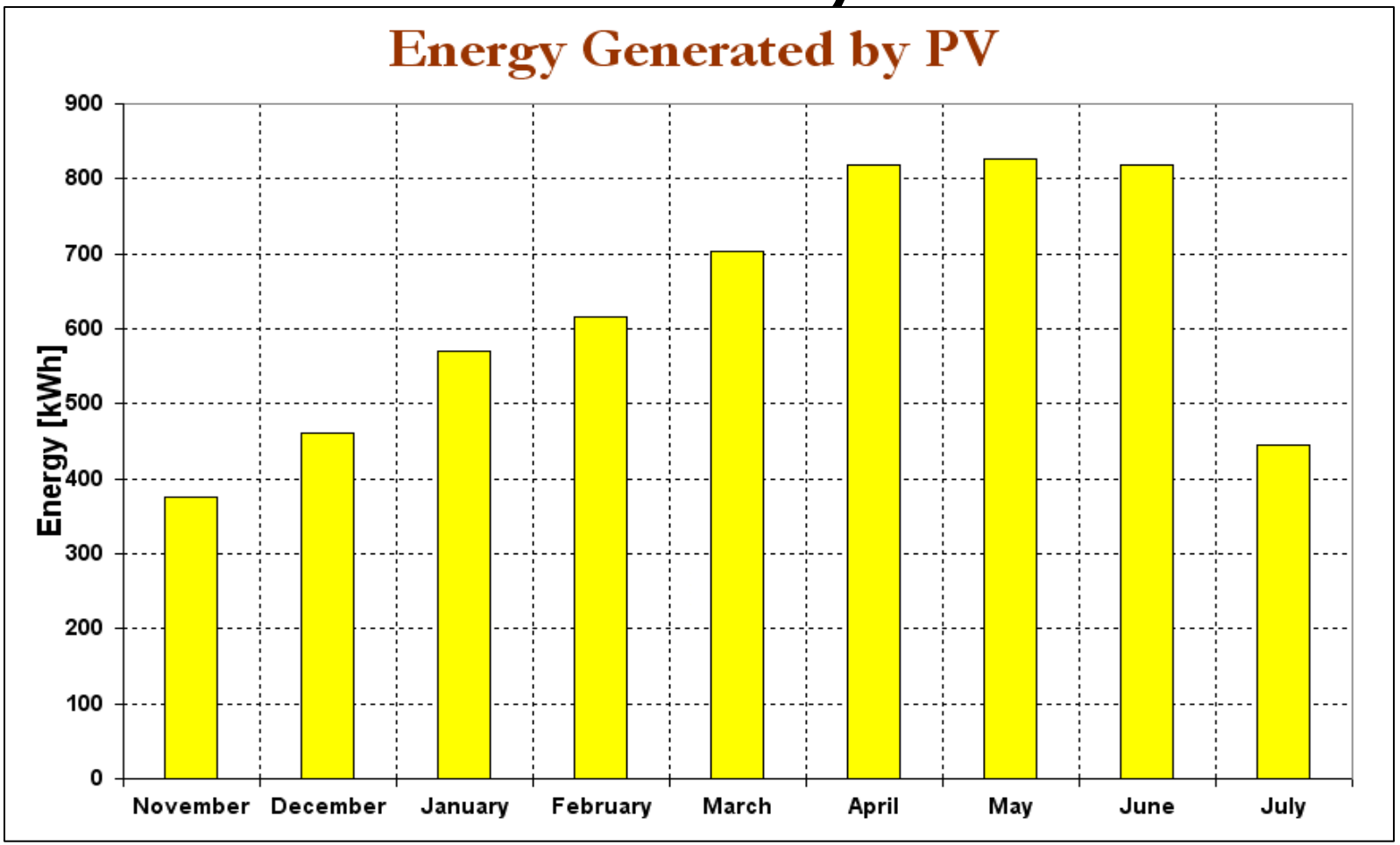


Totals: ZEH = 2,688 kWh Baseline= 9,667 kWh

ZEH Uses 72.2% less grid energy than Baseline

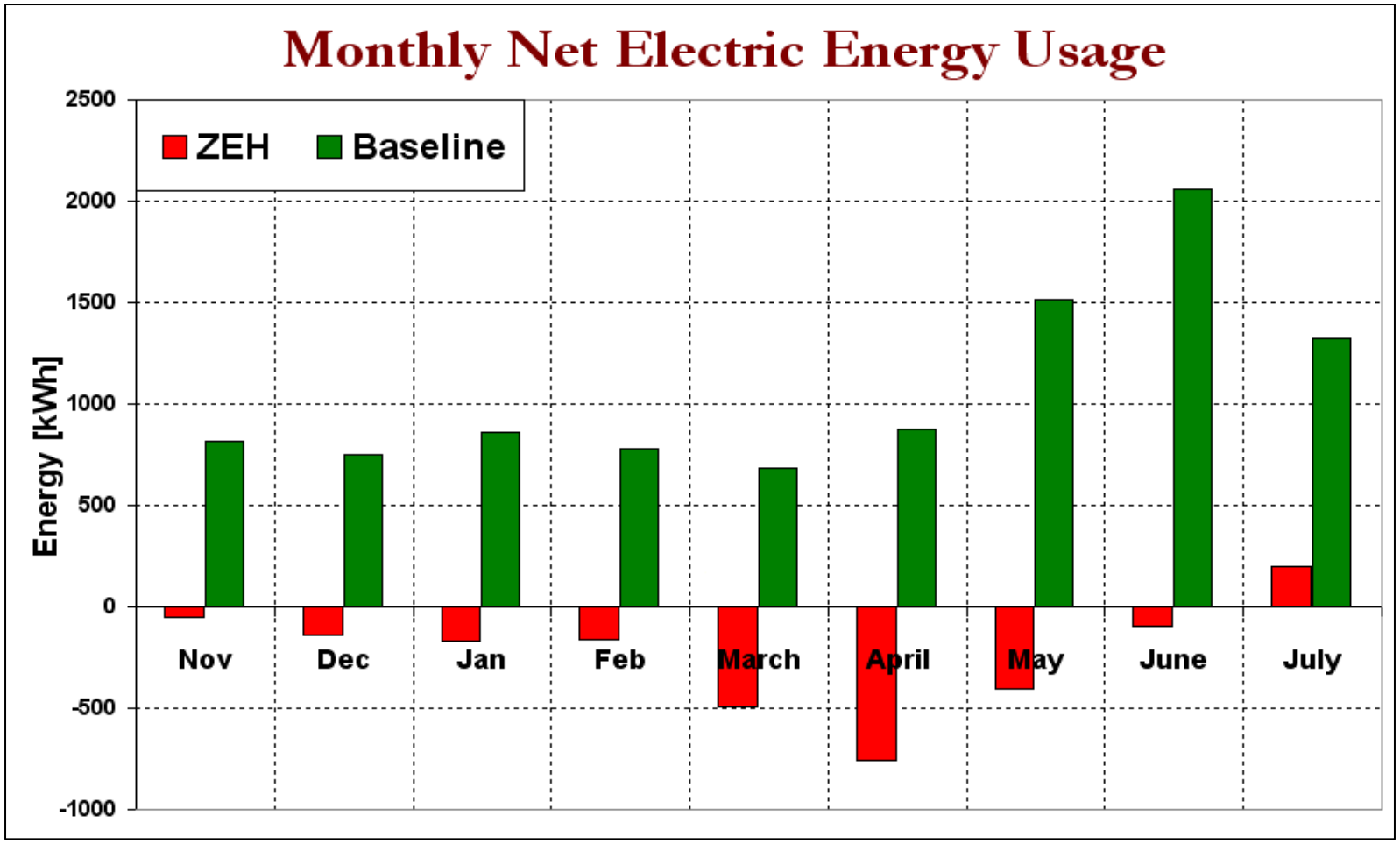
(Note: July data is for partial month at the time of this slide was plotted)

Data Analysis



Total PV produced = 5,634 kWh

Data Analysis



Net Electric Energy = 2,080 kWh excess

Data Analysis

Peak Energy Usage

- Nevada Power Peak Season

  June 1st – September 30th

- Peak Hours

  1:00 pm – 7:00 pm

- Some Data

  June: ZEH used 88% less peak energy

  Overall: ZEH used 85% less peak energy

Energy savings of individual features

Item	Cooling elec. +lights (kWh)		Thermal (kBtu)	
Baseline	5558		29475	
Slab	5480	-78	27171	-2304
Lights	4745	-813	35592	6117
Windows	4764	-794	25923	-3553
Roof	5381	-177	28605	-870
T-Mass	5523	-35	26296	-3179
A/C (Furnace)	3720	-1838	34299	4824

Savings for Each Individual Item In ZEH Compared to Baseline

Item	Cooling elec. +lights (kWh)		Thermal (kBtu)	
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New Zero Energy House Project

- Funded by NV Energy
- Contractors: UNLV CER and Pulte Homes
- Quantify the costs of production homes moving toward zero energy
- Estimate initial cost vs. energy saved
- Hope to supply quantitative data for a rebate program from NV Energy to builders
- Uses Pulte Villa Trieste development

Newest Project: Peak Demand Reduction in a Development

- Funded by the US DOE to UNLV, with NV Energy and Pulte Homes as subcontractors
- Objective is reduce the peak electrical demand for a development at least 65% over standard, code-built homes (we think it may be over 80%)
- Requires some similar concepts a ZEH design, but focuses on peak demand
- Accomplishing by energy conserving design, PV panels, utility-customer price communication and control, storage battery
- Project has just begun, focusing on Villa Trieste development of Pulte Homes

Villa Trieste Development

Development, located near Red Rock National Wilderness Area, has LEED Platinum rating, two-story houses in the range of 1800-2100 sq ft, low $200,000s each. 1.7 kW PV.

Possible Energy Efficiency Upgrades-Villa Trieste Moving Toward Zero Energy

Product	*Code Minimum*	*Current*	*Proposed*	*Upgrade Cost*
Windows	U-Value: 0.65 SHGC: 0.40	Vinyl, Low-E double pane U-Value: 0.36, SHGC: 0.30 UV light transmit.: 14-16%	Vinyl, Low-E double pane U-Value: 0.30, SHGC: 0.27 UV light transmittance: 5%	$120-$160
Air-conditioner	13 SEER	42 kBtu/hr; 15 SEER	17.5 SEER; 20 SEER	$2,200; $3,080
Mechanical Ventilation	Recommended min. 0.35 ACH (typically achieved by infiltration)	Air Cycler with no heat recovery (homes are built tightly, need additional ventilation)	Energy recovery ventilator (ERV)	$2,060
Wall insulation	R-13	2x4 walls R-13 cellulose insulation and 1" EPS (R-4)	2x6 walls R-21 cellulose insulation and 1" EPS (R-4)	$880-$1,060
"	"	"	2x4 walls R-13 cellulose and 1” EPS (R-4) in exterior walls Icynene spray foam (reduced infiltration) in attic and floor	$600-$700
Floor cavity insulation	R-19	R-19 cellulose	R-30 cellulose	$600-$700
Pipe insulation	None	None	All hot water pipes	~$350
Roofing	N/A	Cement tiles directly atop roof sheathing	Raised roof battens	$250-$300

These are builder estimates for production homes in Las Vegas

Summary

- Have demonstrated a way of isolating actual performance of individual components in building of many energy saving items.
- We are now able to supplement that with a cost/benefit analyses at the design stage.
- This will be monitored and evaluated to substantiate the method.
- End result is to have data to furnish to Public Utility Commission for possible rebate program assessment.

Thanks.

Contacts

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